The link between corporate environmental performance and corporate value: a literature review

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Abstract: There is a long-standing debate regarding the link between corporate environmental performance and financial firm performance. Up to the present, this debate has been an important trigger for empirical research. It is often argued, however, that the large body of research concerning this topic has not led to conclusive findings. Mixed results invite a literature study that can clarify the debate and allows for the drawing of conclusions. We focus on studies that examine the impact of corporate pollution as well as corporate initiatives to reduce pollution, and this both within a regulated and a voluntary framework. The literature review reveals that regulation does not enhance the relationship between environmental and financial performance. Legislative actions by governmental bodies merely help in generating environmental awareness among stakeholders as well as in creating a benchmark against which good and bad environmental performance can be defined. It is the stakeholders, enforced by increasing environmental corporate disclosure, who truly force firms to adopt more sustainable business models.

Keywords: Environmental performance, firm performance, pollution, environmental regulation, voluntary environmental programs

JEL classification: Q51, Q58, C25

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1. Introduction

This article provides an overview of the academic literature on the effect of corporate pollution on firm performance. We concentrate on prior research that has investigated the link between corporate pollution as well as corporate efforts to reduce pollution on the one hand, and corporate value on the other hand. The question that is raised in this review is whether the relationship between environmental and financial performance is primarily driven by mandatory environmental regulations or by disclosure efforts in the context of voluntary environmental programs.

A heated and long-running debate has been raging on the impact of corporate pollution on corporate value. The discussion has been stimulated by the tightening of environmental regulations and the increase in investors' environmental awareness, especially since events such as the Rio Earth Summit in 1992 and the Kyoto Protocol in 1997. The link between environmental and financial performance has been explored in a large number of studies, although there is still no agreement about this relationship. Early studies argued that good environmental performance imposes extra costs on firms (Walley and Whitehead, 1994; Palmer et al., 1995) while other, more recent research provides evidence to support a positive link between corporate environmental performance and corporate financial performance (e.g., Konar and Cohen, 2001; Guenster et al., 2011). According to Derwall et al. (2005) improved environmental performance can increase corporate efficiency and thus create a competitive advantage.

Studies on the relationship between corporate pollution and firm performance can be broadly divided into mandatory and voluntary approaches. The fundamental distinction between both approaches lies in polluters being subjected to either explicit costs imposed by legislators in the case of a mandatory program or implicit costs imposed by stakeholders in a voluntary context. Under a voluntary approach, a polluting firm will not participate unless its payoff is at least as high as it would be without participation, meaning that the firm must perceive some gain, or at least no net loss, ensuing from participation. With mandatory approaches regulators are able to impose net costs on polluting firms, thereby making them worse off than they would have been in the absence of the policy (Alberini and Segerson, 2002). Environmental disclosure plays a key role in the effectiveness of voluntary programs as part of the costs/benefits from environmental actions stem from companies' environmental reputations towards their stakeholders. Given the clear difference between mandatory (i.e., regulatory) and voluntary (i.e., disclosure) approaches and its possible impact on the link between environmental and firm performance, we shall distinguish between studies in regulated and voluntary settings.

The economic costs of environmental regulations have been widely debated since the US began to limit water pollution in 1972 through the Clean Air and Water Acts. According to Stewart (1993) it is cheaper for firms to operate in countries where environmental regulation is not enforced since regulation involves fines, financial obligations and administrative or legal action against polluting companies. There is also some evidence suggesting that environmental regulation affects productivity because it forces firms to commit resources to non-productive activities such as environmental auditing, waste treatment and litigation (Gray and Shadbegian, 1995, cited by Ramiah

et al., 2013). Also Sarkis and Cordeiro (2001) and Rassier and Earnhart (2010) provide evidence of a negative relationship between environmental regulation and market value. In contrast to these studies, several authors have argued that environmental regulation creates rather than destroys value. Porter and Van der Linde (1995), for example, question conventional wisdom about the effect of environmental regulation on firm performance by stating that well-designed regulation could improve a firm's competitiveness. This study led to the so-called Porter-hypothesis which postulates that environmental regulation may result in a win-win situation in that it reduces pollution while simultaneously increasing profits.

In addition to mandatory regulations voluntary environmental investments have emerged as important instruments of environmental policy and governance across the world. The central purpose of voluntary environmental approaches is to produce positive externalities beyond the demands of environmental regulation. Firms that voluntarily adopt progressive environmental policies gain credibility by signaling their environmental position to external stakeholders who cannot otherwise fully observe participants' environmental performance (Prakash and Potoski, 2012). There are theoretical arguments both in favor and against the profitability of voluntary environmental efforts. These arguments range from a clear rejection of voluntary environmental investments with them being considered a total waste of money (Friedman, 1970) to a belief that environmental investments not only pay for themselves but also produce a profit in most cases, while improving environmental quality at the same time (Porter and Van der Linde, 1995).

This literature review provides quite consistent evidence of a negative relationship between firms' emissions, both within a regulated and a voluntary framework, and financial performance. Additionally, several studies document a positive association between pollution reduction and firm value. Other studies show that voluntary environmental initiatives mitigate the negative effects of pollution on firm value in the light of stricter environmental regulations. This review therefore confirms the stakeholder theory and resourced-based-view theory suggesting that firms can improve their financial performance by satisfying stakeholders' demands and implementing a proactive environmental strategy. More importantly, it also reveals that disclosure reinforces the positive (stakeholder) effect of environmental initiatives while regulation merely offers a benchmark against which environmental behavior can be measured and compared across firms. Results demonstrate that investors view environmentally proactive firms as better prepared to cope with (expected) future environmental regulation.

The remainder of the review paper is organized as follows. In section 2 we present the most important theories regarding the impact of environmental performance on financial performance. Section 3 reports the empirical research on the link between corporate pollution, within a mandatory regulation framework, and firm value. In section 4 we present the empirical research investigating the relationship between voluntary environmental programs and firm value. Section 5 concludes this review and provides suggestions for future work in the area.

2. Theoretical framework

Although scholars have considered different theoretical views to explain the relationship between corporate environmental performance and firm performance, to date theories have been

inconclusive and empirical evidence has been mixed. In this section we consider the most prominent views.

According to the neoclassical agency theory, the expected costs of a firm's environmental responsibility are likely to outweigh the resulting profits and, hence, a firm's environmental performance is expected to have a negative impact on its profitability (Friedman, 1970). Aupperle et al. (1985) explain this neoclassical rationale by arguing that firms that invest in pollution control will incur costs that outweigh the financial benefits. As a consequence, corporate environmental investments can lead to reduced profits or competitive disadvantage and may therefore result in lower profit expectations by investors. The principal agency theory argument related to environmental performance is that corporate environmental responsibility can introduce an agency problem between a firm's management and its shareholders. Friedman (1970) asserts that engaging in corporate environmental responsibility is symptomatic of an agency problem or a conflict between the interests of managers and shareholders. He argues that managers use corporate environmental responsibility as a means to further their own social, political, or career agendas, at the expense of shareholders. According to this view, resources devoted to environmental responsibility would be spent more wisely on efforts to increase firm efficiency. In short, this agency problem causes a negative relationship between environmental performance and financial performance.

Under the agency view, environmental regulation as well as voluntary environmental disclosure would only exacerbate the negative link between environmental performance and firm performance. As proactive environmental investments are, according to this agency view, not in the interest of shareholder wealth maximization, environmental regulation can only force managers to invest in negative NPV projects. These projects will at best shield the firm from non-compliance fines which never compensate for the wealth loss let alone other additional regulatory costs. Also environmental disclosure would not mitigate the negative impact of environmental investing as it is considered unable under this view to align the environmental agenda with wealth maximization.

The agency perspective has been challenged by Freeman (1984) who, in the context of the stakeholder theory, pointed out that every corporation has relationships with many stakeholders and that these stakeholders both affect and simultaneously are affected by the firm's actions. These stakeholder groups include internal and external constituents. Like shareholders, the other stakeholders may place demands upon the firm. Firms must address these demands or else face negative confrontations with non-shareholder groups, which can lead to diminished shareholder value, through boycotts, lawsuits, protests, etc. From a stakeholder theory perspective, corporate social and environmental performance is assessed in terms of a company meeting the demands of multiple stakeholders. Satisfying stakeholder demands to at least some extent is considered an unavoidable cost of doing business. In particular, stakeholder theory suggests that corporate environmental performance should be positively reflected in a firm's financial performance. This is based on the argument that serving the implicit claims of various stakeholders will enhance a firm's reputation, which will consequently lead to a positive impact on its financial performance.

Under the stakeholder view, voluntary environmental disclosure will reinforce the positive relationship between environmental and firm performance as it increases the exposure of environmental activity towards stakeholders. The role of environmental regulation would be at best ambiguous under this paradigm. Once the stakeholders are convinced of the benefits of environmental responsibility, stakeholder theory predicts that they will enforce conducive behavior upon the company without legislation. If that is the case, government intervention will only create

unnecessary regulatory costs (Blacconiere and Patten, 1994). According to this view, stakeholder pressure exerts a significant influence on firms' implementation of environmental practices while governmental pressures are less relevant (Gonzáles-Benito and Gonzáles-Benito, 2006; Wood and Ross, 2006; Rivera-Camino,2007).
At best, government intervention through environmental regulation can create environmental consciousness in society as a whole and in a later stage provide a benchmark for defining good and bad environmental behavior (Tietenberg, 1990).

The arguments from stakeholder theory can be embedded into the resource-based view of the firm. This perspective, introduced by Wernerfelt (1984) presumes that firms are bundles of heterogeneous capabilities and resources. Barney (2001) maintains that differences in organizational performance are a consequence of the heterogeneity of a firm's resources. Hart (1997) argues that the resource-based view of the firm provides a theory to explain competitive advantage as an outcome of the development of valuable organizational capabilities, such as continuous innovation and stakeholder integration, associated with a proactive integration of environmental issues into strategic management. In brief, this theory implies that environmental responsibility leads to competitive advantages and enhanced firm value. Ruf et al. (2001) state that the stakeholder theory can be complemented by the resource-based view of the firm. From a resource-based view perspective, firms can meet stakeholder demands as a strategic investment, requiring commitments beyond the minimum that is necessary to satisfy stakeholders. By strategically investing in stakeholders' demands, firms gain a competitive advantage through the development of additional, complementary skills (Russo and Fouts, 1997). Russo and Fouts (1997) give an example where a firm has two choices to satisfy the stakeholder requirements for mitigating pollution. The firm could invest in end-of-pipe filtering equipment or the firm could change its production process to reduce pollution. Installing the filtering equipment will satisfy the stakeholders' demands. However, the resource-based view of the firm states that a firm that strategically invests in stakeholders' demands by changing its production process, may enjoy a sustainable competitive advantage over a firm that only installs a filtering equipment.
Under the resource-based view, government intervention through environmental regulation would hardly be relevant as the competitive advantage of proactive environmental activity is by definition firm-specific and cannot create value on an aggregate level. The difference in the disclosure effect between plain stakeholder theory and the resource-based view remains an empirical question as it is not a priori clear whether every type of environmental activity would benefit from increased transparency.

Next to the agency view, implying a negative link, and the stakeholder/resource-based view, suggesting a positive link, McWilliams and Siegel (2001) propose a neutral relationship between environmental and firm performance. They argue that a firm's optimal level of investment in social environmental responsibility can be assessed in an identical way as any other investment by considering demand and supply sides. According to McWilliams and Siegel (2001) firms that do not invest in corporate environmental responsibility will offer their products at lower prices while those firms which incur environmental costs will be able to sell their products at higher prices. Therefore, the relationship between corporate environmental performance and financial performance is expected to be neutral.

The previous discussion shows that the literature is dominated by two opposing views. The negative link between environmental and firm performance is explained by the agency theory whereas the positive link is supported by the stakeholder and resource-based view perspectives. The agency theory implies that environmental responsibility is a misuse of corporate resources that would be better spent on value-added internal projects or returned to shareholders. It also suggests that managers use corporate social responsibility to advance their careers or other personal agendas. Stakeholder theory presents a more positive view on environmental responsibility. This theory asserts that managers must satisfy a variety of stakeholders (e.g., workers, customers, suppliers, local community organizations) who can influence firm outcomes. According to this view, it is not sufficient for managers to focus exclusively on the needs of shareholders. The resource-based view complements stakeholder theory and states that firms should move from mere compliance to active support of stakeholders' environmental requirements to gain a competitive advantage over their competitors. Overall, stakeholder and resource-based view theory suggest that "it pays to be green". In addition to the negative agency and the positive stakeholder/resource-based view there is the neutral approach proposed by McWilliams and Siegel (2001) who argue that firms simply supply a certain demanded level of environmental performance to maximize their profits.

3. Enforcing the environment: mandatory environmental legislation

This section reviews research on the effects of environmental regulation on firm performance as well as studies using environmentally regulated emissions as a proxy for environmental performance.

Historically, policymakers have relied on regulatory restrictions on polluting behavior to guarantee adequate protection of environmental quality. The key theoretical argument for environmental regulation is that pollution is a classic example of an externality, an unintended result of market decisions, which affects individuals other than the decision-makers. Because firm-level decisions do not take into account full social costs, pollutant emissions tend to be higher than socially efficient levels. As environmental quality is thus naturally underprovided for by competitive markets, a potential role arises for environmental regulation (Revesz and Stavins, 2003).

We use a geographical dimension to structure the studies within a mandatory context and discuss them in chronological order starting with the research on US mandatory programs, followed by an overview of the literature on the relationship between carbon performance within the European Union Emission Trading Scheme and firm value. Next we consider some studies on the Australian emission reporting scheme. We end this section by examining the effect of Japanese and Chinese environmental legislation on firm value.

3.1 US Legislation: from the Clean Air Water Act to the SO_2 emission trading scheme

Since 1969 several legislative actions in the United States have been aimed at reducing industrial pollution[2]. Simultaneously the US Securities and Exchange Commission has been engaged in developing pollution disclosure requirements to ensure sufficient disclosure of pollution information (Jaggi & Freedman, 1992) .

[2] See Carriker (1996) for an overview

The impact of US environmental regulation on firm performance has been the subject of many studies. Several studies have analyzed the impact of pollution disclosures within the context of early US environmental regulations. Shane and Spicer (1983), for instance, investigate whether stock price movements are associated with the release of externally produced information about companies' performances in the pollution-control area. Specifically, the study examines stock price movements associated with the disclosure of eight studies conducted by the Council on Economic Priorities (CEP)[3] with regard to firms' environmental performances. The results show that pollution disclosures were associated with market reactions. However, the study of Shane and Spicer (1983) merely analyzes whether the pollution information has *an* impact on market value and not whether there was a positive or negative reaction. A study investigating the signed impact of pollution information on firm performance is Jaggi and Freedman (1992). The authors develop a pollution index based on pollution levels for 13 pulp and paper firms and link the index to economic performance indicators by using the Pearson Correlation test. The results show a negative association between environmental and economic performance and the authors suggest that in the short run a firm's profitability is negatively affected by pollution abatement activities involving high expenditures. This finding provides some support for the neoclassical view that abatement activities are a misuse of firm resources that would be more wisely spent on efforts to increase firm efficiency.
Blacconiere and Northcut (1997) use the event study methodology to examine market reactions for 72 chemical firms to announcements of legislative events leading to the Superfund Amendments and Reauthorization Act (SARA). This act increased direct taxes affecting chemical firms, and expanded regulatory disclosure requirements for firms that release hazardous materials into the environment. The study shows that, due to increased regulatory costs, chemical firms' stock prices had an overall negative reaction to announcements of specific legislative actions (e.g., votes by Congress) leading to the SARA. Furthermore, Blacconiere and Northcut (1997) examine firm-specific environmental information and find that firms with more extensive exposure to regulatory costs experienced a more negative market reaction. These results are in line with the agency perspective that environmental compliance is just an extra cost with no added value.

Since 1987, all US manufacturing facilities with at least 10 employees and producing more than certain benchmarks of each of the 320 listed chemicals, are required to annually report an inventory of toxic releases to the Environmental Protection Agency (EPA). Information about these releases is then publicly disseminated through the Toxics Release Inventory (TRI). Such a requirement informs the public and allows individuals to minimize or avert exposure to toxic substances (Saha and Mohr, 2013). Since TRI is a publicly available database, it is an important metric for stakeholders to measure a company's waste generation and pollution reduction activities across a wide range of industries. Patten (2002) argues that, in support of the use of the TRI data as a proxy for environmental performance, it has the distinct advantage of being based on the same measure for all reporting firms and of covering a large diversified set of firms. These factors have led many scholars to rely on TRI data as the environmental performance indicator of choice.
Hamilton (1995) and Khanna et al. (1998) use event studies to investigate the announcement effect of the yearly TRI data releases. Hamilton (1995) assesses the market reaction to the first release of the TRI data in 1989. For a sample of 436 firms with TRI data, he documents that the average abnormal return on the day the emission information was made public, was equal to -0.284 % and

[3] The CEP is a research organisation, founded in the USA, that analyses and reports on the social and environmental records of companies

statistically significant. In addition, Hamilton (1995) shows that firms reporting TRI information lost on average $ 4.1 million in equity value on the first day the data were released. This is remarkable as the TRI data releases do not involve any explicit costs. Khanna et al. (1998) study the influence of repeated public disclosures of TRI data over the period 1989-1994. Using a sample of 91 firms, they find significant abnormal returns for the day following the release of TRI data for the years 1991-1994. Contrary to Hamilton (1995) they do not find significant abnormal returns following the first release of TRI data. The difference between Hamilton's (1995) results and the Khanna et al. (1998) study could be attributable to differences with respect to the samples of firms being analyzed. Hamilton (1995) studies a sample of 436 firms in the manufacturing sector of which 12% were in the chemical industry. Khanna et al. (1998) on the other hand use a sample of chemical firms that are generally known to be large polluters relative to firms in other industries. Khanna et al. (1998) argue that a first disclosure of environmental information may not generate significant reactions among investors as chemical firms are known to be large polluters. Repeated disclosures of environmental information however, do lead to statistically significant abnormal returns because repeated provision of environmental information allows investors to benchmark a firm's pollution level and make comparisons of performance over time as well as across firms. Khanna et al. (1998) document that firms whose releases increased relative to the previous year or whose pollution levels rose relative to other firms were confronted with significant negative returns. The firms with decreased pollution levels relative to the previous year or relative to other firms reported insignificant returns.

These two studies examining the impact of TRI disclosures on stock prices may struggle with construct validity issues, however. It seems possible that same-day stock price movements probably reflect contemporaneously reported pollution rankings. These rankings are strongly affected by company size and industry choice and thus the stock market effect could be the result of temporary bad press rather than a real change in perception of a firm's long-term value effect of environmental performance. Perhaps for this reason, these TRI event studies have showed inconsistent evidence in a 5-day window following the TRI data release (King and Lenox, 2001).

Another way to explore the link between environmental and financial performance, as opposed to event studies, is to use standard regression techniques to evaluate the effect of changes in pollution on changes in firm performance. This is in essence the methodology used in a study by Hart and Ahuja (1996). Based on a sample of 137 firms from the S&P 500, they show that changes in pollution over the years 1989-1992 were associated with changes in firm performance as proxied by return on sales, return on assets and return on equity. Their proxy for environmental performance, however, conflates reduction of emissions and divestiture of polluting operations, making it difficult to assess the true value of the effect. This raises the question whether it pays to be green or whether it pays to operate in clean industries. To help distinguish the effect of pollution reduction from other underlying factors, Cohen et al. (1997) construct two portfolios of low polluting and high polluting firms in their respective industries, based on the industry categories used to classify companies in the S&P 500 index, and compare accounting returns, measured using return on assets and return on equity, and stock market returns between these portfolios. The authors conclude that investors who choose the environmental leaders in an industry-balanced portfolio do just as well as (or better than) investors choosing the environmental laggards in each industry. King and Lenox (2001) differentiate between pollution performance and divestiture of operations in dirtier industries by splitting environmental performance into two constructs: relative performance within one's industries and the average performance of the industries in which one chooses to operate. For an unbalanced sample of 652 firms constituting 4483 firm-year observations for the years 1987 to 1996, they find

evidence of a positive association between pollution reduction and financial gains, as proxied by Tobin's Q. They fail, however, to derive the direction of causality.
A second study that links environmental performance to Tobin's Q is Konar and Cohen (2001) who relate the market value of 321 S&P 500 firms to environmental performance, as proxied by TRI emissions and environmental lawsuits. After controlling for variables traditionally thought to explain firm-level financial performance, they find that poor environmental performance is associated with lower Tobin's Q values. Clarkson and Li (2004) follow a different approach. Instead of linking emission levels to firm performance, they examine the market valuation of environmental capital expenditures related to pollution abatement using a modified version of the Ohlson (1995) valuation model[4]. Based on a pooled sample of 256 firm-year observations from 29 pulp and paper firms, their valuation evidence indicates that there are incremental economic benefits associated with environmental capital expenditures by high-polluting firms but not low-polluting firms. The negative association between TRI emissions and firm value on the one hand and the positive link between corporate environmental efforts and firm performance on the other hand suggest that good environmental performance increases the market value of the firm. From a stakeholders and resource-based view perspective the increased market value can be explained by the enhanced corporate reputation which is built on the perceptions of its relevant stakeholders. A strong corporate reputation is both an intangible asset and a source of strategic advantage enhancing a corporation's long term ability to create value (Caves and Porter, 1977).

Studies that analyze the impact of US environmental regulation on firm performance have predominantly been undertaken using either valuation models or event studies (e.g., Hamilton (1995); Clarkson and Li, 2004).
Cordeiro and Sarkis (1997) use a different approach and explore the relationship between TRI data and security analyst earnings forecasts as an alternative proxy for firm performance. For a sample of 523 US firms in 1992, they document a significant, negative relationship between the level of TRI emissions and industry analyst 1- and 5-year earnings-per-share performance forecasts. Alternatively, Connors and Silva-Gao (2008) explore the "does it pay to be green" question by focusing on the effects of pollution performance on firm-specific risk. The authors examine whether improved environmental performance, measured as reduced TRI emissions, reduces the cost of equity capital. The results indicate that companies with high TRI emissions have a significantly higher cost of equity capital than those with lower emissions when controlling for beta, leverage, information risk, firm size and growth. These results provide evidence that environmental performance, a non-financial performance measure that is receiving growing public exposure, is reflected in the cost of capital. The negative relationship between environmental performance and cost of equity capital is confirmed by Clarkson et al. (2011a) who examine the relevance of environmental disclosures. The authors conclude that TRI emissions are positively associated with the cost of equity capital but that there is no association between voluntary environmental disclosure, which will be discussed in section 4 of this review, and the cost of equity capital. The negative link between environmental performance and the cost of capital strengthens the

[4] The Ohlson (1995) valuation model is used to estimate abnormal returns and valuation equations. This model is based on the assumption that the market value of a firm's equity can be expressed in terms of a set of 'information variables'. These variables normally include the firm's accounting earnings, the book value of its equity and a variable which captures all other value relevant information not reflected in the firm's accounting records (Ataulah et al. (2006)).

stakeholder argument as improved environmental performance enhances a firm's reputation which may result in reduced risk and consequently a reduced cost of capital (Miles and Covin, 2000).
The use of TRI data to proxy for environmental performance has its limitations, however. First, toxic emissions represent only one aspect of environmental performance since these emissions do not give any information about the pollution with non-toxic substances such as carbon dioxide emissions (Ziegler et al., 2007). Second, TRI is an aggregate measure of 320 chemicals in which the chemicals are not weighted according to relative risk or physical damage (Ilinitch et al., 1998). Third, as production processes and pollution propensity differ across industries, TRI data from different industries are not easily comparable. Fourth, TRI data rely on self-reported emissions. Finally, the EPA reports TRI data with a two-year lag and the data sometimes represent estimated instead of actual emissions. These limitations could bias parameter estimates when conducting multivariate regressions. However, as the advantages outweigh the limitations, the TRI has gained widespread acceptance within the literature and is most widely used as an empirical proxy for environmental performance (Toffel & Marshall, 2004).

Another proxy that has received some attention within the literature involves the sulphur dioxide (SO2) emissions (Hughes, 2000; Johnston et al., 2008). The SO2 emissions are subject to the first emission cap-and-trade system introduced in the US with the passage of Title IV of the 1990 Clean Air Act (CAA)[5]. A cap-and-trade system places a cap, or ceiling, on the aggregate emissions of a group of regulated sources by creating a limited number of tradable emissions allowances for a given period and requiring firms to surrender a quantity of allowances equal to their emissions during that period. The system imposes no particular limits on emissions from any given firm or source. A firm may emit as much as it chooses, as long as it obtains sufficient allowances to do so. The government may initially distribute the allowances for free or sell them at auction. In either case, the need to surrender valuable allowances to cover any emissions and the opportunity to trade those allowances establishes a price on emissions. In turn, this price provides firms with an incentive to reduce their emissions that influences all of their production and investment decisions (Stavins, 2007).
Hughes (2000) uses SO2 emissions to examine the value relevance of future environmental liabilities of electric utility companies. Using a balance sheet-based valuation model, this study shows that, on average, exposure to unbooked environmental liabilities decreased the mean 1990 share price of electric utilities by 16.3 percent. Hughes (2000) concludes that nonfinancial measures such as toxic emissions are considerably informative to stakeholders and that these measures are impounded into the stock price. Johnston et al. (2008) extend Hughes (2000) by examining allowances that are held in excess of current emission levels. Furthermore they investigate stock price reactions to events involving purchases of emission allowances during auctions sponsored by the United States Environmental Protection Agency (USEPA). The authors conclude that the capital market assigns a positive price to a firm's bank of SO2 emission allowances consistent with the argument that emission allowances have an asset value component that is assigned a positive price by the market.

To summarize this section, it can be stated that the empirical evidence on the value implications of environmental performance within the context of US environmental regulation is quite consistent and convincing.

[5] The Title IV of the 1990 Clean Air Act is available on http://www.epa.gov/air/caa/title4.html

Most studies find pollution to be negatively related to firm financial performance. Furthermore, pollution reduction seems positively correlated to firm value, providing evidence for the stakeholder theory and the resource-based view. Studies showing a negative link between pollution reduction and firm value are scarce and dated, implying that the stakeholder and resource-based view arguments have been strengthened over time due to growing environmental awareness amongst stakeholders. From this viewpoint environmental regulation becomes less important as stakeholders place pressure on firms to adopt proactive environmental practices that improve their environmental performance. Instruments such as the Toxics Release Inventory and the SO2 cap-and-trade system stay however useful as these systems encourage the public's awareness over environmental issues and develop a benchmark for environmental performance.

3.2 European Union Emission Trading Scheme

The European Union (EU) launched an EU-wide emissions trading scheme (EU ETS) for carbon emissions in 2005 which can be considered as the cornerstone of the EU climate policy. As already discussed in the previous section, the practice of emissions trading is not particularly novel as trading of sulfur dioxide began in the United States in the 1990s (Burtraw et al. 2005). Carbon trading however, which refers to the trading of six major greenhouse gases[6], is more recent. The EU ETS was the first and is to date the biggest international system for trading greenhouse gas emission allowances, covering almost half of EU's greenhouse emissions and operating in 31 countries (European Commission, 2013)[7]. The EU ETS has been designed to operate in different phases. Phase 1 ran between 2005 and 2007 and could be regarded as a start-up and test period. Phase 2, which comprised the years 2008 to 2012, coincided with the Kyoto Protocol commitment period and required EU Member States to achieve an 8% emission reduction compared with their 1990 level. Phase 3 has the longest compliance period, from 2013 to 2020. Its target is to reach by 2020 an emissions level of 21% less than the 2005 level (Mnif and Davison, 2012).

Although the literature on various aspects of the EU ETS is growing, only a limited number of studies have examined the link between carbon performance and firm performance. Anger and Oberndorfer (2008) examine the impact of carbon performance, measured as the allocated carbon emissions divided by actual carbon emissions, on competitiveness defined as a firm's ability to sell and approximate this ability by firms' market revenues. Additionally they analyse the impact of the EU ETS on employment. Applying a regression analysis for 419 German ETS firms, this study reports no influence of carbon performance on revenues or employment.
Schmidt and Werner (2012) use an event study to examine the impact of announcements on actual carbon emissions by the European Commission on stock prices. The abnormal returns, representing the market reaction, is then linked to carbon performance variables such as actual carbon emissions and over-allocation, defined as the difference between allocated and actual emissions. Using a sample of listed firms from Austria, Denmark, Germany and the UK, this study finds a significant link between abnormal returns and over-allocation for two announcement events, providing some support for the hypothesis that firms with over-allocation are rewarded by investors.

[6] These are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorcarbons (HFCs), perfluorocarbons(PFCs and sulphur hexafluoride (SF6)
[7] The EU ETS operates in the 27 EU countries, the three EEA-EFTA states (Iceland, Liechtenstein and Norway) and Croatia (joined in 2013)

The value relevance of emission allowances is examined by Clarkson et al. (2014) who use an Ohlson valuation model and base their study on a sample of 843 firm-year observations over the period 2005-2010. Measuring the firm's pollution level as its shortage in emission allowances, they find a negative relation between this measure and market value. The authors also find that the negative association between firm values and carbon emission shortfalls is mitigated for firms with better carbon performance relative to their industry peers and for firms improving their environmental performance. These findings are consistent with the notion that the market not only bases its assessment on the firm's current emissions profile but also on its anticipated future profile. These findings provide evidence for the stakeholders theory.

Overall, a limited number of studies have examined the carbon performance, within the EU ETS, providing some evidence that a surplus of emission allowances is positively associated with firm performance. These results are in line with the findings of Johnston et al. (2008), discussed in the previous section. According to Fornaro et al. (2009) companies face increasing pressure from their stakeholders to measure, disclose, monitor and manage carbon emissions. Therefore, the positive link between excess allowances and firm value is not surprising as firms address the demands of various stakeholders by complying with carbon emission regulation. First, regulated firms that do not meet the emission limits could suffer a loss of reputation as these firms are perceived by stakeholders as failing to address climate risks (Hrasky, 2011). Second, there is a value effect as trade in emission allowances gives value to reducing CO2 emissions and has formed a market with an asset value worth tens of millions of Euros annually (Miclaus et al., 2008).

3.3 The Australian ETS

The effect of environmental regulation on Australian firms' performance is an important issue, given the level of commitment Australia has assigned to green policies, particularly with respect to climate change[8]. It is also important as Australia is one of the largest per capita producers of greenhouse emissions (Ramiah et al., 2013). Yongqing et al. (2013) investigate the potential impacts of an emission trading scheme, which was approved by the Australian government in November 2012. Based on a sample of 200 Australian Securities Exchange indexed companies from 2006 to 2010 and using Heckman's (1979) two-step approach to control for the self-selection bias, this study finds that asset values and operating cash flows will be adversely affected by the reduction plan. Specifically, the book value of long-lived assets is found to be negatively associated with listed companies' carbon emission levels. In addition, this study shows that operating cash flows will decrease for emissions-liable companies. Although operating cash flows have been found to be negatively correlated with emission levels, the empirical results document that this influence is not significant. Yongqing et al. (2013) use the carbon emission data disclosed by the Carbon Disclosure Project (CDP), which is an independent not-for-profit organization with the largest available database of corporate climate change information worldwide. The CDP data have been used in several research papers (e.g., Freedman and Jaggi, 2009; Matsumura et al., 2011) and will be discussed in further detail in Chapter Four.

Chapple et al. (2013) use the event study approach to examine the impact of the proposed Australian emission trading scheme on market value and identify five distinct information events argued to impact the probability of a proposed emission trading scheme being enacted and find evidence that

[8] See Bates (2010) for an overview

the capital market evaluates the impact of the proposed ETS on firm performance. For a sample of 58 firms with available greenhouse gas emissions data, listed on the Australian Stock Exchange, the authors find a negative reaction to all four events argued to increase the likelihood, although only one was statistically significant, and a significant positive reaction to the one event argued to decrease the likelihood of an emission trading scheme. Further, when the authors divide their sample into high and low carbon-intensive firms, they detect a stronger market reaction for the most carbon-intensive firms. Chapple et al. (2013) use data from the Australian National Pollutant Inventory (NPI) to proxy for environmental performance. The NPI works in the same manner as the US Toxic Release Inventory and requires all installations that emit above threshold levels to submit annual reports that quantify their emissions of various land, water and air pollutants. This information is disclosed on the NPI website. Thus, the advantages of using TRI to assess environmental performance also apply to NPI. However, the NPI database has an additional advantage in that it assigns a total risk score to each substance and reports the emissions of individual substances for each facility. These risk scores reflect the relative risk that the substance poses as a function of its environmental hazard, human health hazard and likelihood of exposure to the Australian population or environment (Clarkson et al., 2011c). Ramiah et al. (2013) extend the study of Chapple et al. (2013) and investigate the impact of 19 announcements of environmental regulations using a sample of 1770 companies over the period 2005-2011. Additionally, they estimate the change in systematic risk following the announcements. Remarkably, this study shows that the wealth of shareholders in the electricity industry did not change, which indicates that the biggest polluters are not affected by the introduction of green policies. The authors make the plausible assumption that polluters are passing higher costs to consumers. The shareholders of other industries that are not viewed as the biggest polluters experienced value destruction, with no compensation for these industries. These findings conflict somewhat with the results of Yongqing et al. (2013) and Chapple et al. (2013) who detect a more pronounced negative reaction to the proposed emission trading for companies which are considered to be carbon-intensive.

Overall these studies show that the proposed Australian ETS is relevant to investors and is perceived as having a negative impact on the market value of polluting firms. Further research is needed to assess the actual impact of the scheme and the effect of polluting abatement activities on the firm performance of Australian firms.

3.4 Green policies in Japan and China

Political commitment to mitigate climate change is increasing throughout Asia, a region accounting for nearly half of the world's carbon emission in 2010. Numerous laws, regulations, procedures and initiatives on protection of natural resources and the environment have been enacted by Asian governments (Calvin et al., 2012). Examples include the Chinese Environmental Impact Assessment Law of 2003[9] or the Japanese Basic Anti-Global Warming Law of 2010[10]. Thus, Asia is an important region to consider in any discussion of the impact of environmental regulation on firm performance.

The effect of environmental regulation on Asian firms' performance however, has only scarcely been studied. In the Japanese context, Nishitani and Kokubu (2011) and Nishitani et al. (2011) use panel

[9] See Bao et al. (2004) for a discussion
[10] See Adachi and Kikuyama (2010)

data on manufacturing firms listed in 2009 on the First Section of the Tokyo Stock Exchange, which meet the reporting requirements of Japan's mandatory GHG accounting and reporting system. Using data on 641 Japanese manufacturing firms in the period 2006-2008, Nishitani and Kokubu (2011) examine the influence of firms' reductions of greenhouse gas (GHG) emissions on firm value, measured by Tobin's q. In order to further explore this relationship, this study analyzes not only the effect of the reduction of GHG emissions on firm value but also that of the market discipline imposed by the investors in terms of the reduction of GHG emissions. The empirical estimations prove that firms' reduction of GHG emissions enhances their firm value but also that this occurs where the market discipline imposed by the investors is strong, providing evidence for the stakeholders theory. Nishitani et al. (2011) analyze how a firm's reduction of GHG emissions affects its economic performance, based on a theoretical model derived from the Cobb-Douglas production function and the inverse demand function. In line with the results of Nishitani and Kokubu (2011) the results show that the reduction of GHG emissions increases a firm's economic performance.

Given that China has been the world's second-largest carbon emitter for years and has even overtaken the USA as the world's largest emitter since 2007, environmental protection and energy saving have become important issues in the Chinese government's and firm boards' agenda (Tsang and Kolk, 2010). So far, the only study examining Chinese firms' environmental protection efforts on firm performance is Ye et al. (2013). This paper studies the impact of energy saving efforts on the market values of firms by using the announcement date of the carbon emission rights trading scheme (CERTS) in China as an exogenous shock. The results, based on an event study with a sample of all listed firms in China's Shenzhen Stock Exchange (SZESE), indicate that the efforts of firms on environmental protection were positively valued when the emission trading scheme was introduced. These results suggest that investors pay increasing attention to efforts related to corporate environmental protection and that firms with more investments in energy saving attract more investors and have more potential increments on their firm value within the framework of an emission trading scheme. The positive effect of environmental protection efforts, enhanced by the introduction of the CERTS, on firm value is in line with the stakeholders and resource-based view.

4. Environmental self-regulation: Voluntary environmental programs

Traditionally, the predominant approach to addressing the environmental problems emanating from the private sector was through mandatory environmental regulation. This instrument for environmental protection has however been increasingly criticised for not providing satisfactory answers to the complex environmental problems that society now faces (Annandale et al., 2004). A consequence of this criticism has been the growth of a variety of self-regulating voluntary instruments as supplements and potential alternatives to traditional regulatory approaches. One such instrument, the voluntary environmental program (VEP), is designed to provide participants with incentives to improve their environmental performance. By the late 1990s there were over a dozen voluntary environmental programs and thousands of participating firms in the United States, and this number has continued to grow (Videras and Alberini, 2000).
According to the stakeholders theory, discussed in section 2, voluntary environmental programs have a positive impact on firm value as firms receive a variety of benefits in return for their participation. These benefits include the publicity aspect (Videras and Alberini, 2000), the possibility to signal its willingness to satisfy stakeholders' environmental demands (Ruf et al, 2001) and obtaining goodwill

and standing with critical stakeholders (Darnall et al., 2009). The resource - based view provides several additional reasons for firms to join VEPs including the ability to signal the proactivity in its environmental management, therefore indicating that they are greener and cleaner than non-participants (Darnall and Carmin, 2005) and to gain a competitive advantage (Videras and Alberini, 2000).
On the other hand, in the context of the agency theory, participation in VEPs as an indicator of corporate social responsibility, is indicative of self serving behaviour on the part of managers and thus reduces shareholder wealth (McWilliams and Siegel, 2006).

Most of the empirical literature has focused on mandatory disclosure programs as discussed in the previous section. Voluntary disclosure has received less empirical attention, perhaps because of severe self-selection problems when analyzing data (Kim and Lyon, 2011). Most of this work is in the accounting literature and aims to explain the extent of attention to environmental matters in corporate annual reports and corporate social responsibility reports (e.g., Patten, 2002). Little is known about the extent to which voluntary disclosures directly affect financial performance. In this section we review this limited research. We start by focusing on studies linking the Carbon Disclosure Project data to market data followed by a discussion of other VEPs and their impact on firm value. We end this section by analyzing three studies that assess the impact of corporate environmental disclosure on market value.

4.1 Carbon Disclosure Project

The Carbon Disclosure Project (CDP) is a United Kingdom's based not-for-profit-organization, formed in 2000 as a United Nations initiative. Its mission is to gather and disseminate climate change information in an effort to create a unified response against global warming (Carbon Disclosure Project, 2013). To achieve this goal the CDP enlists the support of signatory institutional investors. Each year the CDP sends a questionnaire to the largest global companies requesting climate change information on behalf of these institutional investors. The results are accessible by the investors as they are received by the CDP and publicly released between September and December.
The data disclosed by the CDP offers some distinctive opportunities for voluntary environmental disclosure research as compared to environmental information released in annual reports and sustainability reports. As Stanny and Ely (2008) indicate annual and sustainability reports are very broad in nature. They include information about all major sustainability issues, making inferences about specific environmental issues very difficult. Furthermore, annual reports include financial information and as Cormier et al. (1993) point out, any market reaction could be caused by correlated relevant financial information. The data disclosed by the CDP is information specifically related to the issue of climate change and the reports are publicized independent of annual reports or other financial information. Recently researchers have started to use CDP data to examine the impact of participation in the CDP and the effect of carbon emissions on firm performance. From the stakeholder perspective, participation in the CDP should be rewarded by investors as CDP participants meet the stakeholders' demand for environmental disclosures (Clarkson, 1995).
Kim and Lyon (2011) examine the effect of CDP participation on share prices for a sample of FT global 500 companies by using the event study methodology. They compare the abnormal returns surrounding CDP disclosures during the period 2003-2006 between participants and non-participants. Contrary to expectations, no evidence is found that participation increased shareholder

value. However, by making use of Russia's ratification of the Kyoto Protocol on October 22, 2004, which caused the Protocol to go into effect in all the nations that had ratified it, Kim and Lyon (2011) find that companies' CDP participation increased shareholder value. These results imply that Russia's ratification increased the pressure on the USA and other countries that had not yet ratified Kyoto, to take action on climate change. Consequently, firms in such countries saw the probability of environmental regulation rise. Investors apparently viewed CDP participants as better prepared to deal with climate regulations, leading to increased market value (Kim and Lyon, 2011). While Kim and Lyon (2011) are the only researchers to examine the announcement effect of CDP participation, there are several studies that have considered the link between firms' carbon intensity and its market value by using CDP data. The CDP studies are conceptually similar to those reported in section 3 of this literature review with the only difference that the former uses self-reported CDP data as a proxy for carbon intensity while the latter is based on emission data, subject to environmental regulation. As a consequence these studies should yield similar results, given that the self-selection bias is properly accounted for.

Aggarwal and Dow (2011) study the effect of greenhouse gas emissions on firm value, as proxied by Tobin's Q, for a sample of 621 large firms from the US, Canada and Europe that filed 2008 emission data with the Carbon Disclosure Project. They conclude that carbon intensity is negatively associated with firm value. Furthermore they obtain information about firms' emission mitigation strategies from the CDP questionnaires and document a positive, although insignificant effect of emission mitigation on firm value. Misani et al. (2011) study the relationship between the firm carbon intensity and its market value by analyzing a worldwide sample of 164 firms that have disclosed their greenhouse gas emissions through the CDP in 2006-2008. Similar to Aggarwal and Dow (2011) they also measure firms' organizational responsiveness to climate change by using the qualitative items in the CDP questionnaire. Misani et al. (2011) conclude that carbon intensity is negatively associated with firm market value and that organizational responsiveness to climate change moderates this negative relationship. They suggest that firms that strive to define environmental strategies to reduce their greenhouse gas emissions protect themselves against the negative valuation that investors assign to high polluting companies. These results are in line with Kim and Lyon (2011) who demonstrate that investors view CDP participants as better prepared to cope with future environmental regulation. These studies provide evidence for the resource-based view which states that proactive firms have a competitive advantage over their less green competitors.

Matsumura et al. (2011) investigate the relationship between carbon emissions and firm value for S&P 500 firms disclosing their carbon emissions to the Carbon Disclosure Project over the period 2006-2008. Using a modified variant of the Ohlson valuation model, Matsumura et al. (2011) find a negative association between carbon emission levels and firm value, contingent upon managers' decisions to disclose this non-financial information in the first place. This negative relationship is most pronounced for the high carbon-intensive companies within their sample. Further, Matsumura et al. (2011) indicate that their results involve, on average, a penalty of $202 for every additional metric ton[11] of carbon emissions. They note that this penalty is large considering spot carbon prices below $40 per metric and suggest there are also indirect costs associated with carbon emissions, including potential litigation costs, remediation costs, and loss of reputation, which together add to the total carbon emissions cost. Griffin et al. (2011) also employ a modified Ohlson-type valuation model to assess the effect of greenhouse gas emissions on firm value. They use CDP data on US firms

[11] Greenhouse gas emissions are typically expressed in metric tons, an international unit of measurement equivalent to approximately 2200 pounds (EPA, 2011)

from the S&P 500 over the period 2006-2009 and Canadian firms from the TSE 200 over the period 2005-2009. To control for the self selection bias they estimate carbon emissions for non-disclosures based on the data provided by firms that do disclose. Similar to Matsumura et al. (2011) they conclude that greenhouse gas emissions are negatively associated to firm value and this negative relation is more pronounced for high carbon-intensive firms. This finding is in line with the stakeholder theory as high polluting firms face higher pressure from environmental groups, compared to less polluting firms. Additionally pollution measures capture the exposure of high pollution firms to future environmental liabilities.
Lee et al. (2013) use the event study methodology to investigate market responses to the release of Korean CDP data for 16 firms in 2008 and 50 firms in 2009, all from the KRK 100 index. In addition they examine the moderating effect of frequent carbon communication on the relationship between carbon disclosure and shareholder value by examining a number of articles from 22 Korean newspapers. Their results show that the market responds negatively to firms' carbon emissions disclosure and that a firm can mitigate this negative shock by releasing its carbon news periodically through the media in advance of its carbon disclosure. This last result is not very surprising as the information effect of CDP disclosure is small when firms provide carbon information beforehand.

The CDP data is however not without its limitations. Because the CDP is a voluntary program, firms can respond as they see fit. They can provide all or some of the requested information, or they can decline to participate (Knox-Hayes and Levy, 2011).

In concluding this section, we note that the impact of pollution data disclosed by the Carbon Disclosure Project, on financial performance, does not yield different results compared to pollution data provided within a mandatory context: A firm's polluting level is negatively correlated to its financial performance. There is however some evidence that the negative link between pollution and firm value can be mitigated by voluntarily organizational responsiveness to climate change which is in line with the stakeholders and resource-based view. Through participation in VEPs firms are able to mitigate environmental pressure imposed by various stakeholders.

4.2 Other voluntary approaches

The US EPA is the largest sponsor of US-based voluntarily environmental programs. By the end of the 1990s, about 13000 firms were participating in EPA-sponsored VEPs (Mazurek, 2002). The 33/50 program was the first voluntary program established by the US EPA. It was established in 1991 with the goal of reducing the aggregate releases of 17 toxic chemicals by 33 percent by 1992 and by 50 percent by 1995, relative to the level in 1988. Firms had the flexibility in the extent of reduction they achieved and in the methods they chose to reduce their releases (EPA, 1999).
Khanna and Damon (1998) use a sample of 123 firms over the period 1991-1993 to examine the impact of the 33/50 program on firms' return on investment (ROI) and expected long run profitability of firms, measured as the excess of market value over the book value of assets normalized by sales. Controlling for sample selection bias, they conclude that the 33/50 program has a significant, negative effect on the ROI but its impact on the long-term profitability is significantly positive. These results imply that the costs of pollution investments were not offset in the short run by improvement in consumer goodwill and improvements in production efficiency. In the long run however, investors expect that the pollution control efforts will improve the firm's profitability.

Keele and DeHart (2011) use the event study approach to assess how the stocks of publicly traded companies respond to the announcement of their partnership with EPA's Climate Leaders program, a VEP established in 2002. Each US based company that voluntarily joins this program commits to fulfilling a corporate-wide greenhouse gas inventory and to working with EPA to set a corporate emission reduction target. Using a sample of 29 firms, Keele and DeHart (2011) show that the stocks earn an average non-significant positive abnormal return of 0.56% on the day of the announcement, although the cumulative abnormal returns for the stock prices of the firms for two of the three event windows showed statistically significant negative returns. These results suggest that the firms' public announcements of joining the USEPA Climate Leaders did not have a positive impact on stock performance. Fisher-Vanden and Thorburn (2011) also examine the announcement effect of firms joining Climate Leaders. Based on a larger sample of 74 firms their results reveal that companies announcing membership in EPA's Climate Leaders experience significantly negative abnormal returns. Further Fisher-Vanden and Thorburn (2011) also examine 20 announcements of firms joining Coalition for Environmentally Responsible Economies (CERES), a program involving more general environmental commitments, and show that these announcements are associated with insignificant abnormal returns. Finally, given the significantly negative impact on stock price from Climate Leaders membership, they analyse why firms would join this VEP by conducting a probit analysis. The results show that firms with a higher number of shareholder resolutions directed at climate change are more likely to be members of the Climate Leaders program. Controlling for these resolutions, they also find that firms with weak corporate governance structures are more likely Climate Leaders members. Fisher-Vanden and Thorburn (2011) conclude that firms are joining the Climate Leaders program either because they are facing institutional pressures to do so, or because managers face less shareholder oversight, allowing them the possibility to join voluntarily environmental programs. From the agency theory perspective the second explanation is more plausible as it would explain the negative abnormal returns following the announcement to join Climate Leaders by arguing that managers join Climate Leaders to further their own agendas, at the expense of shareholders.

A voluntary environmental program that does not fall under the umbrella of the EPA is the Chicago Climate Exchange (CCX). The CCX was established in 2003 and launched trading operations of the first cap and trade system in North America that made voluntary but legally binding commitments to reduce six different types of greenhouse gas emissions. Market participants included major corporations, utilities and financial institutions with activities in all 50 United States, 8 Canadian provinces and 16 countries. The total program baseline covered approximately 700 million metric tons of carbon dioxide (CO2), equal to roughly one-third the size of Europe's cap and trade program (Chicago Climate Exchange, 2011). Gans and Hintermann (2013) analyse the stock return behaviour of member firms of the Chicago Climate Exchange (CCX) on a monthly basis. They base their study on a difference-in-difference framework. To control for self-selection bias into the voluntary program, they construct control groups of non-member firms based on propensity score matching. The authors find positive and statistically significant excess returns after firms announce their decision to join CCX. These findings are not in line with the results of Fisher-Vanden and Thorburn (2011) who find that firms announcing membership in the VEP Climate Leaders experience significantly negative abnormal returns. Gans and Hintermann (2013) additionally investigate the financial impact of the Waxman-Markey Bill on members of the CCX. The Waxman-Markey Bill proposed, among other things, the introduction of a cap-and-trade system which would regulate the emission of greenhouse gases in the United States. Under the bill, over the next 40 years carbon emissions would be

increasingly decreased to 83% compared 2005 levels. Gans and Hintermann (2013) argue that this bill raised the likelihood of a mandatory cap-and-trade system being instituted in the medium term. They find that the passing of the Waxman- Markey climate bill leads to positive and statistically significant excess returns for CCX member firms relative to non-member firms, implying that firms who had gained experience in the voluntary market are rewarded for being prepared for future regulation. This finding is similar to the study of Kim and Lyon (2011) who find that companies' CDP participation increased shareholder value following Russia's ratification of the Kyoto Protocol.

Overall, studies that examine the relationship between market value and partnerships with VEP's find mixed results. These inconclusive results could be attributable to different beliefs of investors about the benefit of membership or different goals altogether. If joining a VEP introduces an agency problem between managers and shareholders, announcing participation should be associated with negative abnormal returns. On the other hand, following the stakeholders perspective, joining VEPs should be rewarded if VEPs are perceived as helpful tools to satisfy stakeholders' environmental demands. Firms participating in voluntary initiatives should therefore communicate the benefits of VEPs clearly with their investors to avoid any agency problems.

4.3 Disclosure of green performance

The link between green performance and firm performance, within the framework of mandatory or voluntary environmental programs, has been subject to a large amount of research, as reported in previous sections. Another set of studies analyses the impact of corporate green performance disclosures, published by the company itself or by non-profit organizations, on market value.

As stakeholder theory suggests that firms must satisfy several groups (e.g., the government, non-governmental organizations, employees) that have some interest or in a firm, It can be worthwhile for firms to report on environmental efforts because otherwise these stakeholders could withdraw their support (Ziegler et al., 2011). Furthermore, from the resource based view perspective, a good reputation due to the disclosure of corporate environmental measures is an example of an intangible resource. Overall, the stakeholder and resource based view theory suggest that the link between disclosed corporate environmental efforts should be positive.
However, it can also be argued that the disclosure of corporate environmental activities is not a result of proactivity. In contrast, the disclosure of corporate environmental efforts could be an answer to institutional pressures due to the increasing discussion about climate change (Ziegler et al., 2011). In this case, pollution abatement activities could be a reactive strategy so that the demanded investments lead to unexpected costs (e.g., King and Lenox, 2001). Following the agency cost theory this cost argument is considered the standard argument for a negative relationship between corporate environmental performance and financial performance. As a consequence the disclosure of corporate environmental efforts should have a negative impact on a firm's financial performance.

An example of a non-profit organization disclosing corporate green performance information is Climate Counts. Its goal is putting pressure on corporations into reducing contributions to climate change. Climate Counts scores the world's largest companies on their climate impact to spur corporate climate responsibility and conscious consumption (Climate Counts, 2013). Beatty and

Shimshack (2010) explore the capital market impact of the disclosure of Climate Counts' scores in June 2007. They find, by conducting an event study with 47 observations, that the release of climate ratings had a significant impact on stock prices. This result is primarily driven by penalties to firms receiving poor climate performance ratings while this study does not provide significant evidence that good ratings are associated with positive abnormal returns.

Griffin and Sun (2013) analyse the announcement effect of firms' voluntary disclosures about greenhouse gas emissions made through the Corporate Social Responsibility newswire service (CSRwire), a digital media platform that claims to be the global leader in climate change disclosure. For a sample of 172 disclosures by 84 US listed companies over 2000-2010, they document that the voluntary green disclosure provides shareholders with positive returns. Ziegler et al. (2011) analyse the relationship between disclosed corporate responses to climate change and stock performance. They use a sample of European and US firms across the time period of 2001 to 2006 and argue that the awareness of climate change and the stringency of climate policy were generally higher in Europe compared to the USA. In contrast to studies using long-term firm performance indicators or short-run event studies, Ziegler et al. (2011) examine the average stock performance of portfolios that differ in their disclosure practices. In order to estimate the corresponding risk-adjusted returns, they apply the four-factor model according to Carhart (1997) in addition to the one-factor model based on the CAPM. The results document that a trading strategy which consists of buying stocks of corporations disclosing responses to climate change and selling stock of corporations with no disclosures has become more worthwhile over time in Europe and has particularly been rewarded in the period of 2004 to 2006. The authors conclude that the stock performance of firms with a higher level of disclosed responses to climate change is slightly more positive in regions and periods with a higher institutional pressure with respect to global warming and thus a more stringent general or sectoral climate policy regime than in regions and periods with weaker climate policy. Another finding is that the relationship between disclosed corporate responses to climate change and stock performance is positive for energy firms. Ziegler et al. (2011) argue that their findings support the stakeholder theory as stakeholders have a bigger appetite for environmental disclosures in regions with higher climate change awareness. In addition energy firms are more severely observed, for example, by non-governmental organizations. As a consequence, good relationships with stakeholders are more important for this group of firms (e.g., Sprengel and Busch, 2011). Altogether, previous discussed studies document that the disclosure of voluntary environmental efforts are positively valued by investors as they address stakeholders' environmental demands and obtain goodwill.

5. Conclusion, implications and future research

The aim of this article was to review and discuss the academic literature regarding the link between pollution performance and financial performance. We address the question whether the link between environmental and financial performance is driven by environmental regulation or by disclosure efforts through voluntary environmental initiatives.

According to early agency arguments firms that invest in pollution control will incur costs that outweigh their financial benefits. As a consequence, corporate environmental investments can lead to reduced profits, decreased firm values, or competitive disadvantage and therefore result in lower profit expectations of investors (Aupperle et al., 1985). Subsequently, researches have challenged this view indicating that "it pays to be green". Argued arguments from a stakeholders and resource-based view perspective include obtaining goodwill and standing with critical stakeholders, cost

efficiencies associated with innovation, gaining a competitive advantage and reducing risks of future mandatory regulation. Following the stakeholder perspective, environmental regulation seems less relevant as stakeholder will enforce environmental responsibility upon the company without legislation imposed.

Overall, this review supports the positive link between corporate environmental performance and financial performance. The literature provides quite consistent evidence of a negative relationship between firms' emissions, both within a regulated and voluntary framework, and financial performance. Additionally, several studies found a positive association between pollution reduction and firm value.

Studies that evaluate the link between market value and partnerships with voluntary environmental programs are inconclusive. These inconclusive results could be attributable to different beliefs of investors about the benefit of participation in VEP's. Several studies find however that voluntary environmental initiatives mitigate the negative effects of pollution on firm value in the light of stricter environmental regulations.

The positive link between, pollution reduction and firm value and the mitigating effect of voluntary environmental initiatives and disclosures provide evidence for the stakeholder theory and resourced-based-view theory suggesting that firms can improve their financial performance by satisfying stakeholders' demands and implementing a proactive strategy. It is the stakeholders therefore who, enforced by enhancing environmental corporate disclosure, truly force firms to implement environmental practices, while governmental pressures are less relevant.

This review implies that managers do not face a trade off between environmental and financial performance. Thus, the reduction of polluting emissions as well as other environmental performance is an appropriate business strategy that does not conflict with firms' economic incentives. Therefore, managers are recommended to reduce polluting emissions to enhance their economic performance and disclose these initiatives effectively to their stakeholders. Further, this review shows that a proactive approach towards environmental requirements instead of meeting compliance at minimum costs could create a sustainable advantage. Firms engaging in voluntary initiatives should however communicate the benefits of participation clearly with their investors to avoid any agency problems. In fact firms should include environmental performance as an integral part of corporate strategy, allowing managers the time and resources they need to manage the environmental challenges. A clear proactive environmental strategy should not only guide the development of competencies but also shape the firm's relationship with employees, suppliers, customers, policy makers, and all other stakeholders (Hart, 1997). However, according to Clarkson et al. (2011c) only firms with sufficient financial resources and management capabilities can pursue a proactive environmental strategy. Given these resource constraints, policy makers should provide firms with incentives to improve their environmental performance. For instance, higher tax benefits associated with green investments or market-based mechanism such as emission trading schemes. Such schemes also provide the public with benchmarks against which good and bad environmental performance can be defined. In addition, environmental regulation needs to encourage the participation in VEPs rather than to penalize polluters. Technical assistance provided by such programs can assist firms in understanding and identifying technical solutions that are needed to address their environmental challenges. Furthermore policies should provide channels through which superior environmental performance can be disclosed. Public recognition of superior environmental

performance can be a substantial incentive as such recognition could lead to economic gains in the form of stakeholders' goodwill.

Further, these findings do not necessarily imply that investors can use information about a firm's environmental strategy to earn abnormal returns, they do suggest that investors and analysts should consider a firm's environmental performance when forming investment strategies. This review shows that firms following a more proactive environmental strategy, satisfying the demands of various stakeholders, are more likely to attract investors to buy their stocks and enhance their share returns ultimately.

In terms of future research, it would be interesting to investigate, following Ziegler et al. (2011), how institutional pressure with respect to global warming contributes to the relationship between environmental and financial performance. Further, the research on the relationship between carbon performance and firm performance, within the framework of cap-and-trade programs such as the EU ETS or the Australian ETS, is rather scarce. More research is needed to understand the impact of emission trading on firm performance as it is not clear whether the impact is driven by a reputation or a value effect, or a combination of the two.
Research on the link between pollution and firm performance has been based on pollution data such as that provided by the TRI database, only representing certain aspects of environmental performance. In this sense the relationship between environmental and firm performance has only partially been examined. In terms of future research, it would be interesting to discover the full picture of the environmental performance -firm performance link. However this task is far from easy due to lack of complete data on firms' environmental performance. Next, the majority of studies summarized in this review examine the relationship between environmental and financial performance from the perspective of market-based measures of firm performance. There is considerably less research, especially in a non-US context that has focused on the link between a firm's environmental performance and its cost of capital. Finally, further research is recommended to examine how firm characteristics affect the link between environmental performance and firm performance. The relationship between firm characteristics and environmental performance is likely to be complex.

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